

WHAT IS CLAIMED IS:

- 1                    1.        An acoustic transducer for measuring a property of a fluid,  
2        the acoustic transducer comprising:  
3                    an acoustic pulse generator; and  
4                    a buffer assembly between the pulse generator and the fluid, the  
5        buffer assembly being composed of a core and a sleeve shrink fitted over the core  
6        to form a cladding that reduces dispersion of the acoustic pulses traveling through  
7        the core.
- 1                    2.        The acoustic transducer of claim 1 wherein the sleeve has a  
2        thermal conductivity of at least 15 W/(m·K).
- 1                    3.        The acoustic transducer of claim 1 wherein the sleeve is made  
2        of titanium.
- 1                    4.        The acoustic transducer of claim 1 wherein the core has a  
2        thermal conductivity of less than 15 W/(m·K).
- 1                    5.        The acoustic transducer of claim 1 wherein the core has a  
2        thermal conductivity of less than 1 W/(m·K).
- 1                    6.        The acoustic transducer of claim 1 wherein the core is made  
2        of fused silica.
- 1                    7.        The acoustic transducer of claim 6 wherein the core is made  
2        of a composite of fused silica and mica.
- 1                    8.        The acoustic transducer of claim 1 wherein the sleeve is  
2        secured to the core by high temperature glass fusing.
- 1                    9.        The acoustic transducer of claim 1 wherein the high  
2        temperature glass fusing of the sleeve and core forms a hermitic seal.

1                    10.    The acoustic transducer of claim 1 wherein the sleeve is  
2    secured to the core with a refractory cement.

1                    11.    The acoustic transducer of claim 1 wherein the sleeve is made  
2    of metal.

1                    12.    The acoustic transducer of claim 1 further comprising:  
2                    a thermal management system mounted to the sleeve to transfer heat  
3    from the sleeve, wherein the thermal management system is formed of a high  
4    thermal conductivity material and is arranged along the sleeve such that substantial  
5    heat is transferred to the environment from the thermal management system without  
6    excessive temperature increase at the pulse generator.

1                    13.    The acoustic transducer of claim 12 wherein the thermal  
2    management system includes a plurality of fins.

1                    14.    The acoustic transducer of claim 1 wherein the sleeve is made  
2    of a material having a bulk sound speed greater than a bulk sound speed of the core  
3    material.

1                    15.    The acoustic transducer of claim 1 wherein the sleeve is made  
2    of a material having a bulk sound speed less than a bulk sound speed of the core  
3    material, and wherein the sleeve is configured in a way that adds stiffness thereto.

1                    16.    The acoustic transducer of claim 1 wherein during operation  
2    at least a portion of the core extends into the fluid which is being measured and  
3    wherein the sleeve is arranged to insulate the sides of the extended core portion from  
4    heat from the fluid while leaving the tip of the core in contact with the fluid such  
5    that the insulated core portion is not cladded.

1                    17.    The acoustic transducer of claim 1 wherein the insulated  
2    portion of the core sides is insulated by an air gap formed by the sleeve.

1                   18.     In combination with an apparatus including a conduit through  
2     which fluid flows, the improvement comprising:

3                   an acoustic transducer for measuring a property of a fluid, the  
4     acoustic transducer including an acoustic pulse generator and a buffer assembly  
5     between the pulse generator and the fluid, the buffer assembly being composed of  
6     a core formed of a low thermal conductivity material and a sleeve shrink fitted over  
7     the core to form a cladding that reduces dispersion of the acoustic pulses traveling  
8     through the core.

1                   19.     The combination of claim 18 wherein the sleeve is secured to  
2     the core by high temperature glass fusing.

1                   20.     The combination of claim 18 wherein the sleeve is secured to  
2     the core with a refractory cement.

1                   21.     The combination of claim 18 wherein the sleeve is made of  
2     metal.

1                   22.     The combination of claim 18 further comprising:  
2                   a thermal management system mounted to the sleeve to transfer heat  
3     from the sleeve, wherein the thermal management system is formed of a high  
4     thermal conductivity material and is arranged along the sleeve such that substantial  
5     heat is transferred to the environment from the thermal management system without  
6     excessive temperature increase at the pulse generator.

1                   23.     The combination of claim 22 wherein the thermal management  
2     system includes a plurality of fins.

1                   24.     The combination of claim 18 wherein during operation at least  
2     a portion of the core extends into the fluid which is being measured and wherein the  
3     sleeve is arranged to insulate the sides of the extended core portion from heat from

4 the fluid while leaving the tip of the core in contact with the fluid such that the  
5 insulated core portion is not cladde.

1 25. The combination of claim 18 wherein the insulated portion of  
2 the core sides is insulated by an air gap formed by the sleeve.

1 26. A sampling system comprising:  
2 a fluid inlet for receiving a fluid;  
3 a dilution inlet for receiving a dilution gas;  
4 a mixing section for mixing at least a portion of the fluid with the  
5 dilution gas;  
6 a collection section for collecting a sample of the mixture; and  
7 a flow meter for measuring a flow related to the sampling system, the  
8 flow meter including an acoustic transducer for measuring the flow, the acoustic  
9 transducer including an acoustic pulse generator and a buffer assembly between the  
10 pulse generator and the fluid, the buffer assembly being composed of a core formed  
11 of a low thermal conductivity material and a sleeve shrink fitted over the core to  
12 form a cladding that reduces dispersion of the acoustic pulses traveling through the  
13 core.

1 27. The sampling system of claim 26 wherein the flow meter  
2 includes a pair of acoustic transducers arranged in an opposed fashion in a conduit  
3 through which fluid flows for measuring the flow.

1 28. A sampling system comprising:  
2 a sample line for sampling a fluid from a main conduit;  
3 a flow meter for measuring a flow of the fluid through the main  
4 conduit, the flow meter including an acoustic transducer for measuring the flow, the  
5 acoustic transducer including an acoustic pulse generator and a buffer assembly  
6 between the pulse generator and the fluid, the buffer assembly being composed of  
7 a core formed of a low thermal conductivity material and a sleeve shrink fitted over  
8 the core to form a cladding that reduces dispersion of the acoustic pulses traveling  
9 through the core;

10                   a dilution inlet for receiving a dilution gas;  
11                   a mixing section for mixing the fluid flow from the sample line with  
12 the dilution gas at a generally fixed ratio;  
13                   a collection section for sampling the mixture, the mixture being  
14 sampled at a rate generally proportional to the flow of the fluid through the main  
15 conduit

1                   29.    The sampling system of claim 26 wherein the flow meter  
2 includes a pair of acoustic transducers arranged in an opposed fashion in the main  
3 conduit.